Implementation of the IS-USG website for sheep pregnancy detection

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Abstract. Sheep pregnancy plays a crucial role in sustaining livestock productivity. Modern detection typically relies on ultrasound examinations, yet the use of ultrasound in sheep management remains limited, and the interpretation of results is often recorded manually. This situation leads to challenges in data accuracy, storage, image archiving, and the preparation of structured reports. This study introduces an innovative IS-Ultrasound (IS-USG) system, developed as a web-based platform for managing sheep pregnancy data. The system is designed to digitally and systematically document ultrasound examination results using intelligent system approaches. The IS-USG website includes features for registering animal identities, uploading and storing ultrasound images, organizing examination archives, and generating pregnancy reports accessible at any time. The research process involves need assessment, system design, development using the Laravel framework, and testing of functionality and user experience. The evaluation results indicate that the IS-USG system successfully performs all intended features, offers a user-friendly interface, and enhances inspection efficiency. Overall, this system is expected to make the pregnancy detection process in sheep more structured, precise, and practical, ultimately supporting higher productivity in sheep farming.

1 Introduction

One of the government programs of the Republic of Indonesia in 2023 is food independence, and one of the pillars is meat independence [1]. According to the Agricultural Data and Information System Center in 2020, the demand for goat or lamb meat in 2023 is estimated to reach 10,000 tons [2] . Sheep are small ruminant animals that are still classified as relatives of goats, cows, and buffaloes. The advantages of raising sheep include: it can adapt to various environments, producing two types of products, namely wool and meat, sheep can also use low-quality feed. An adult ewe is capable of giving birth to more than one child at a time [3]. A female mother is said to have the trait *Prolific* if the number of children born in one birth

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is more than two. It is further explained that factors that affect the number of offspring born are the age of the mother, the weight of the mother's body, the type of birth, the males used, the season (in sub-tropical sheep), the level of nutrition [4].
In the nursery business, the main goal is to produce many and quality saplings. The more lambs produced, the more income that will be obtained from the business. The productivity of the sheep can be determined through the total birth weight, the total weaning weight, *litter size* as well as the child's vitality until weaning and lambing intervals. *Litter size* is the number of offspring calculated based on the number of lambs born from a single birth, *litter size* is one of the factors that determine the productivity of sheep. The calving distance is the distance between one birth and the next in livestock, cattle with a short calving distance show the highest livestock productivity, on the other hand, cattle with a long calving distance show low productivity.
A fertile mother is able to produce two to three offspring [5]. Research in New Zealand conducted in outdoor pastoral settings has reported the loss of lambs from birth to weaning of 14% to 20% for lambs born with twins and 28% to 56% for triplet lambs [6]. Based on this research, the author can determine whether the sheep is pregnant and contains how many children or fetuses are pregnant, if it is known early that the sheep is pregnant, then more intensive care is carried out on the pregnant sheep. With the development of the world of medicine, a tool was created to take photos or videos from inside the sheep's belly called ultrasound (ultrasound), with this tool it makes it easier for farmers and minimizes losses experienced by farmers.
Ultrasound is a method of reading medical data using images that is commonly used to detect, monitor, and diagnose various medical conditions in the body of objects, in humans or animals. Ultrasound can also be interpreted as the second most commonly used imaging format in veterinary practice. Ultrasound uses ultrasonic sound waves in the frequency range of 1.5– 15 *megahertz* (MHz) to create images of body structures based on echo patterns reflected from the imagined tissues and organs. (Jimmy C. Lattimer, 2019). Ultrasound has become an important diagnostic tool in veterinary medicine, particularly in monitoring pregnancy in livestock such as sheep. Identification of pregnancy in sheep through ultrasound imaging is a crucial process in the management of reproduction and breeding of livestock [7].

2 Materials and Methods

This research method includes the stages of developing a web-based information system to support the detection of sheep pregnancy. The stages of the research method are explained as follows :

2.1 Needs Analysis

At the needs analysis stage, the system is designed with functional and non-functional aspects in mind. Functional needs include the main features that must be available in a web-based application, including user authentication through login and registration menus, sheep data management, facilities to upload ultrasound images, and results pages displaying pregnancy status information. These features are intended to ensure that the system is able to provide services that are in accordance with its intended use.
Meanwhile, non-functional needs place more emphasis on the quality of the developed system. Some of them are the security of user data, ease of use of the interface so that it can be accessed by farmers and related parties, and system accessibility that allows applications to run consistently on various devices.

2.2 System Planning

The system design stage was carried out to illustrate how the web-based application is built to meet the specified requirements. At this stage, the system architecture was defined to describe the communication flow between the user interface, the server, and the database. The database was designed to store essential information such as user data, sheep records, and detection history, with considerations for storage efficiency, table relationships, and data integrity. To clarify the workflow, a flowchart and an Entity Relationship Diagram (ERD) were created as visual representations, where the flowchart illustrates the overall business processes and the ERD defines the relationships between entities. This design ensures that the system has a clear, structured, and easily implementable framework.

2.3 User Interface Design

The user interface is designed to provide ease of access to key features of the system. Login and registration pages are provided for user authentication, so only registered users can access the system. After successfully logging in, users are redirected to the home page which displays the main navigation as well as a summary of the available data.
In addition, the system provides a dedicated page for input and upload sheep data, which allows users to add new information as well as upload relevant images. The results of the process are displayed on the classification page, which clearly presents the pregnancy status of the sheep. The design of each page is made simple, intuitive, and easy to understand, so that it can be used effectively by farmers and related parties.

2.4 Website Implementation

The implementation stage is carried out by applying the system design into the form of program code using the chosen web framework. At this stage, the pre-arranged interface design is transformed into dynamic pages that can be accessed by the user through the browser. In addition, integration with databases is carried out to ensure that the storage and processing processes of data, such as user information, sheep data, and detection history, can run properly. This implementation is an important stage in realizing a functional web-based system according to predetermined needs.
System testing is done to ensure that all features in the web-based application are working as planned. Functionality tests were carried out on each main module, such as the login process, sheep data input, image upload, and the appearance of detection results. Each module is tested to run error-free and produce the appropriate output.
In addition, testing also includes interface evaluation through user acceptance testing. This stage is important so that the system not only runs technically, but also provides an intuitive, simple, and appropriate user experience.

3 Results and Discussion

The following are the results and discussions based on the stages of the activities that have been carried out:

3.1 Needs Analysis Results

The results of the needs analysis show that the web-based system developed must meet two main categories, namely functional and non-functional needs. Functional needs include the provision of login and registration features for user authentication, sheep data management which includes adding and managing information, facilities for uploading ultrasound images, and results pages that clearly display pregnancy status. Meanwhile, non-functional needs emphasize the quality aspects of the system, including the security of user data, ease of use through a simple and intuitive interface, and accessibility so that the system can run well on various devices and browsers.

3.2 System Design Results

The system design stage is carried out to produce a clear picture of the structure and workflow of the web-based application to be built. This design aims to make the system have a structured, easy-to-understand, and implementable framework according to user needs. At this stage, the design is carried out through several aspects, namely the preparation of flowcharts to illustrate the process flow, the creation of an Entity Relationship Diagram (ERD) to model the database, and the design of the user interface as an initial representation of the application's appearance.

a. Flowchart

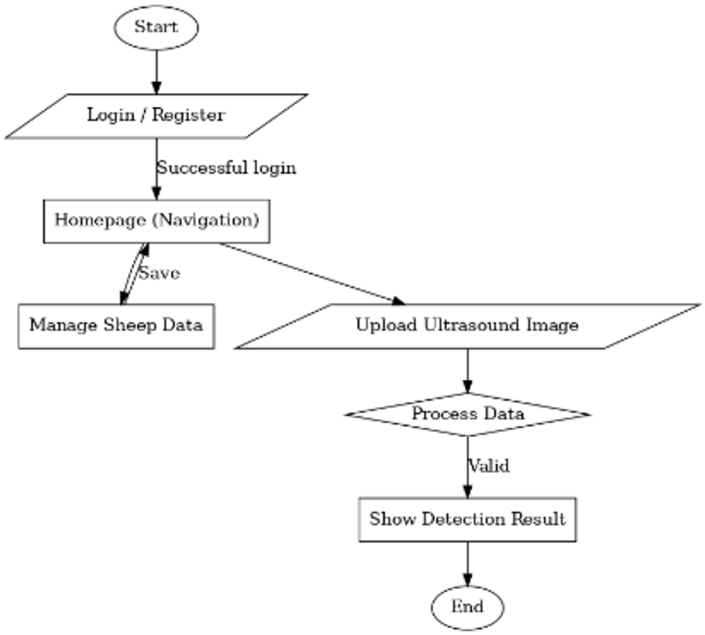

Fig. 1. Flowchart

The system flowchart illustrates the sequence of processes within the web application. It begins when the user performs a login or registration to access the system. Once authenticated, the user is directed to the homepage, which provides the main navigation. From here, the user can choose to manage sheep data, such as adding or updating information, or upload ultrasound images as input data. The system then processes the uploaded data, and the detection result is displayed on a dedicated page. This flowchart ensures that all system processes are clearly defined and systematically connected.

b. Entity Relationship Diagram

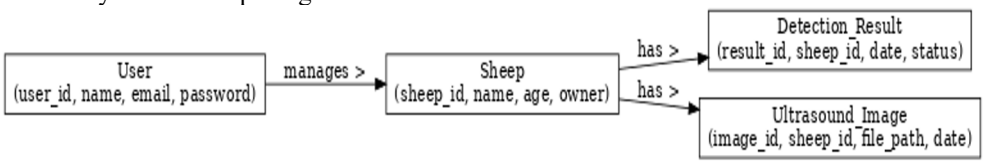

Fig. 2. Entity Relationship Diagram

The Entity Relationship Diagram (ERD) represents the logical structure of the database used in the web application. The system consists of four main entities: User, Sheep, Ultrasound Image, and Detection Result. The User entity manages one or more Sheep, each Sheep can have multiple Ultrasound Images, and the detection process produces a Detection Result associated with each sheep. This ERD design ensures that the data relationships are clearly defined, data integrity is maintained, and the database supports efficient data management for the system.

3.3 User Interface Design Results

a. Login Page Interface

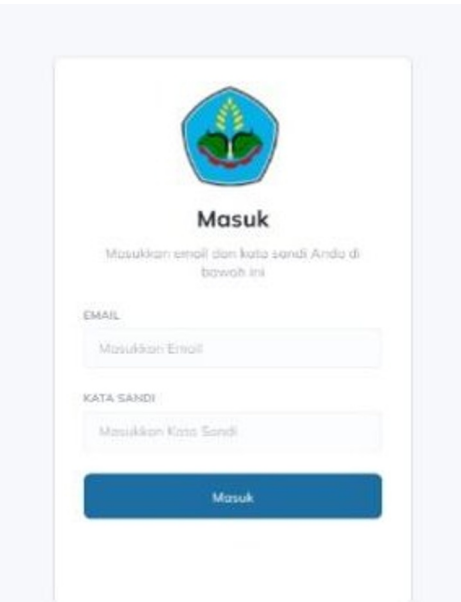

Fig. 1. Login Page

The login page serves as the initial gateway for users to be able to access the system. On this page, users are asked to enter their pre-registered email address and password. If the authentication data matches, the user can log in and proceed to the home page. However, if an input error occurs, the system will display a notification in the form of an error message. The design of the login page is made simple with a clear form display, so that it is easy for users to understand and can minimize errors during the authentication process.

b. Home Page Interface

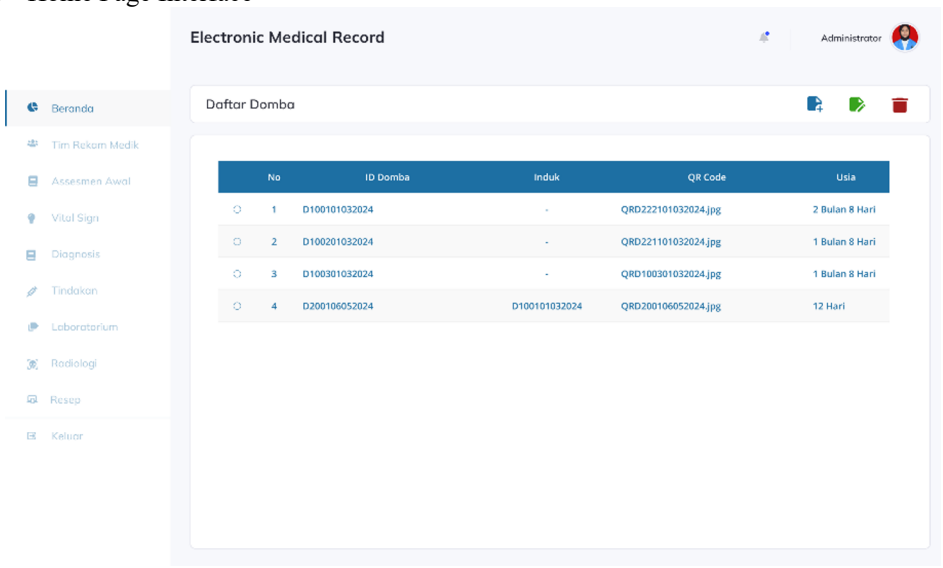

Fig. 2. Home Page

The home page becomes the main display after the user successfully enters the system. On this page, a list of registered sheep is displayed along with basic information on sheep identity. Users can also add new sheep data or manage existing data through the available menu. The list view is made in the form of a table to be more structured and easier to find and manage data. In addition, the home page also features a main navigation to access other features such as uploading ultrasound images and viewing the detection results. With a simple and informative design, the home page serves as a hub for user activity within the system.

c. Sheep Data Page Interface

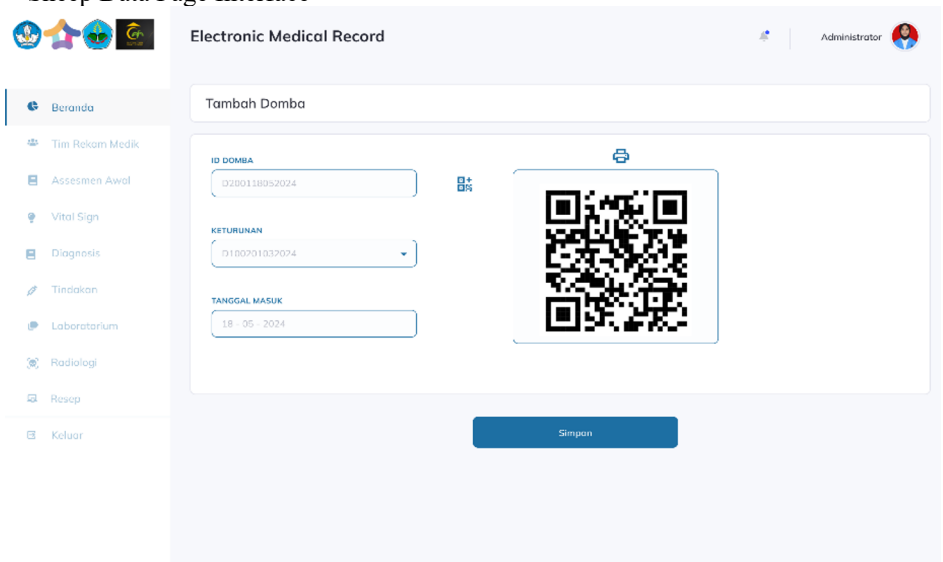

Fig. 3. Sheep Data Page

The sheep data page displays complete information about each sheep registered in the system, including sheep ID, name, age, gender, owner, and inspection history. The information is displayed in the form of a table so that it is easy for users to read and manage. In addition, this page is also equipped with an input form that allows users to add new sheep data or update existing data. With this design, the sheep data page functions as an information management center that supports the smooth pregnancy detection process.

d. Sheep Detection Page Interface

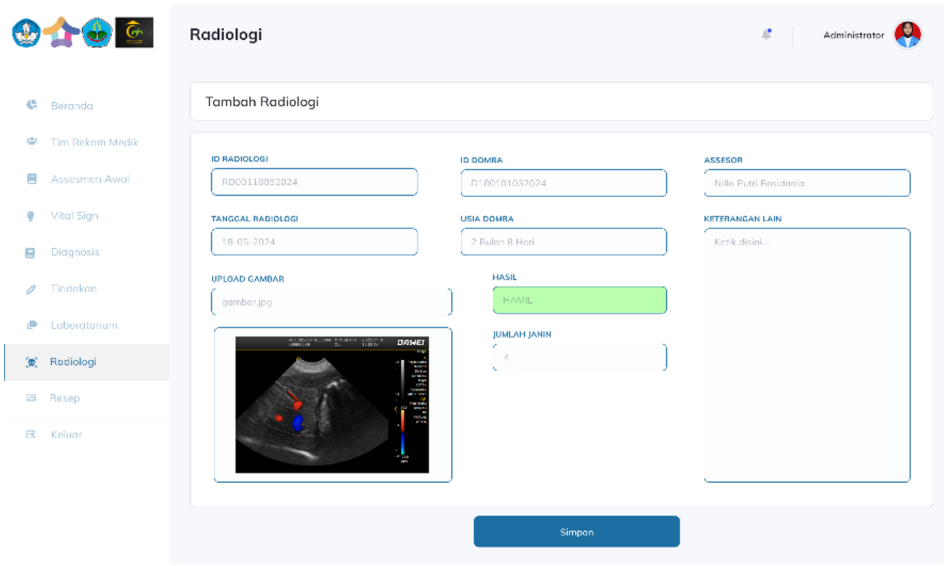

Fig. 4. Sheep Detection Page

The sheep detection page is designed as a key feature that allows users to upload ultrasound images for analysis by the system. On this page, there is a file upload form that supports image input according to the specified format. Once the image is selected and sent, the system processes the data and displays the detection results on the screen. The results displayed are in the form of sheep pregnancy status, accompanied by relevant supporting information. The page design is made simple with a clear flow, making it easier for users, especially breeders, to carry out the inspection process quickly and practically.

3.4 Website Implementation Results

The results of the implementation show that the web-based system has been successfully built according to the design that has been made. The authentication feature through the login and registration pages works well so that only registered users can access the system. The home page displays a structured list of sheep, complete with menus for adding and managing data. In addition, the input form on the sheep data page functions optimally in storing new information into the database. The ultrasound image upload feature can be used to input image data, which is then processed and the results displayed on the detection page. The entire interface page is designed to be simple, easy to understand, and responsive, so that it can provide a good user experience for farmers and related parties.

3.5 System Test Results

The system test uses User Acceptance Testing (UAT) which is carried out to assess the level of user satisfaction with the web application that has been built. The evaluation was carried out by distributing questionnaires through Google Form to five respondents as user representatives. The questionnaire contains ten questions that focus on aspects of the app's functionality, ease of use, and display on Android devices. Each question is graded using a five-point scale with different weights, ranging from Very Easy (score 5), Easy (score 4), Ordinary (score 3), Difficult (score 2), to Very Difficult (score 1) as shown in Table 4.4. The results of the user response calculation are shown in the following table:

Table 1. User Response Calculation Results

TIM	SM X 5	M X 4	B X 3	S X 2	SS X 1	∑nP	And
P1	10	8	3	0	0	21	84%
P2	0	20	0	0	0	20	80%
P3	5	16	0	0	0	21	84%
P4	10	12	0	0	0	22	88%
P5	15	8	0	0	0	23	92%
P6	10	12	0	0	0	22	88%
P7	0	8	9	0	0	17	68%
P8	5	16	0	0	0	21	84%
P9	5	16	0	0	0	21	84%
P10	15	8	0	0	0	23	92%
Average Score Percentage							83%

Based on the calculations, the percentage value of each question varied, with the lowest score of 68% on the question about the ease of adding radiology data, and the highest score of 92% on the question related to the logout process and the ease of changing the sheep data. Overall, the app earned an average score of 83%, which is in the "Excellent" category. This shows that the developed web application has been well received by users and according to their needs.

4 Results and Discussion

The development of the IS-Ultrasound website for sheep pregnancy detection has succeeded in producing a web-based system that meets both functional and non-functional needs. Key features, such as user authentication, sheep data management, ultrasound image upload, and the appearance of the detection results have gone according to design and can be used well by users. The results of the User Acceptance Testing (UAT) involving five respondents showed an average acceptance rate of 83%, which is included in the very good category. This proves that the system built has been well accepted by users, is easy to use, and is able to support the sheep pregnancy detection process in a more regular, practical, and efficient manner. In addition, the IS-USG website also contributes to improving data management, accessibility, and overall sheep farm business productivity.

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